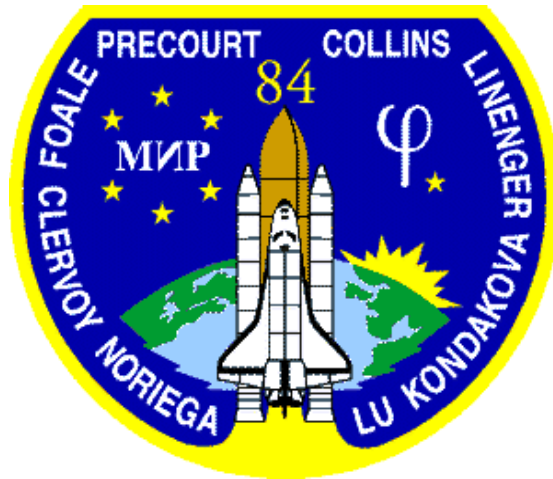


SHUTTLE PAYLOAD SUPPORT CONTRACT (SPSC)

STS-84 POST MISSION REPORT



**FINAL
MAY 1997**



**CDRL A008
CONTRACT #: FO 4701-93-C-0023
PREPARED BY: MUÑIZ ENGINEERING, INC.**

INTRODUCTION

This document satisfies the requirements for the preparation of the STS-84 Post Mission Report, CDRL A008. This document was prepared by Muñiz Engineering, Inc. (MEI) under the Shuttle Payload Support Contract (SPSC). Questions regarding the content of this report should be directed to Mr. Dave Hess, Space and Missile Systems Center/TELH, Johnson Space Center Houston TX 281-483-3498, or Mr. Kip McClung, Program Manager MEI/SPSC Houston TX 281-283-6156.

This document provides the mission overview, payload descriptions, mission objectives, payload activities and accomplishments, summary of console operations, and lessons learned for the DOD-sponsored payloads manifested on STS-84. The DOD sponsored payloads for this mission were Cosmic Radiation Effects and Activation Monitor (CREAM-08), Midcourse Space Experiment (MSX-07), and Radiation Monitoring Equipment (RME-III-20).

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1.0 MISSION OVERVIEW

The Space Test Program (STP) payload complement on STS-84 consisted of CREAM and RME-III, with MSX classified as a secondary payload but with no onboard hardware.

1.1 STS-84 FLIGHT OVERVIEW

Launch occurred at 0308 CST on Thursday 15 May 1997.

The mission profile was as follows:

Orbiter: Atlantis/OV-104

Insertion Altitude: 160 nm

Inclination: 51.6°

Launch: Planned: 0308 CST 15 May 1997

Actual: 0308 CST 15 May 1997

Mission Duration: Planned: 9 Days

Actual: 9 Days, 5 Hours and 20 Minutes

Landing: Planned: 0649 CDT KSC 24 May 1997

Actual: 0828 CDT KSC 24 May 1997

<u>Crew</u>	<u>7 (One astronaut exchange)</u>	<u>DOD Payload Assignment</u>
CDR	Charlie Precourt	MSX
PLT	Eileen Collins	CREAM / MSX
MS1	Jean-Francois Clervoy	RME-III
MS2	Carlos Noriega	
MS3	Edward Lu	RME-III
MS4	Elena Kondakova	CREAM
MS5	Mike Foale (arriving to MIR)	
MS5	Jerry Linenger(returning from MIR)	

DOD PAYLOAD

CREAM

RME-III

MSX

LOCATION

Middeck

Spacehab

None

1.2 EXPERIMENT DESCRIPTION AND OBJECTIVES

Note: For a more detailed description of the payloads/hardware, please reference the STS-84 Operations Support Plan for that particular payload.

1.2.1 CREAM

This was the second flight of the CREAM as an ISS Risk Mitigation Experiment sponsored by Phase One. The CREAM flight hardware consists of an Active Monitor, five Passive Detector Packages, one Passive Crystal Scintillation Canister and one Passive Neutron Spectrometer. The Active Monitor is used to obtain real-time spectral data, while the Passive Packages obtain data integrated over the entire mission duration.

The objective of the CREAM payload is to collect data on cosmic ray ionization spectra, neutron fluxes, and induced radioactivity as a function of geomagnetic coordinates and detector location within the orbiter. The data acquired by the CREAM is expected to assist in the understanding of cosmic-ray induced single event upsets.

1.2.2 MSX

Orbiter thruster firings will be used as a sensor calibration and evaluation target for the space-based ultraviolet, visible, and S-Band sensors on the MSX satellite. There is no flight hardware associated with this payload. The MSX satellite is in a 99 degree, 485 nautical mile semi sun-synchronous orbit.

MSX now consists of only one type of cooperative test: Plume Light Using MSX Emission Sensors [PLUMES]. For STS-84, the PI has identified one test. This test is to observe an OMS or PRCS thruster firing.

1.2.3 RME-III

The Radiation Monitoring Equipment - III (RME-III) is a self-contained, portable radiation detection unit which measures and records ionizing radiation in three different energy levels. The data is time-tagged and stored in the memory modules for downloading and analysis post-mission.

This was the first flight of the RME - III as a ISS Risk Mitigation Experiment. This was also the first Department of Defense payload to transfer to the Mir Space Station.

2.0 PAYLOAD ACTIVITIES AND ANOMALIES

2.1 PRELAUNCH

2.1.1 CREAM

All experiment-required preflight processing activities were accomplished in Spacehab Processing Facility in Cape Canaveral, Florida by the CREAM and STP/SPSC personnel. All activities were accomplished in accordance with the requirements of the Prelaunch Processing Procedures. The CREAM Integration activity was successfully completed per schedule and no prelaunch anomalies were identified.

The two Passive Control Packages attached to the front of the CREAM middeck locker were removed on schedule at approximately L-14 hours and immediately placed within the protective lead-lined boxes.

2.1.2 MSX

None

2.1.3 RME-III

All experiment-required preflight processing activities were accomplished in Spacehab Payload Processing Facility in Cape Canaveral, Florida by the RME-III and STP/SPSC personnel. All activities were accomplished in accordance with the requirements of the Prelaunch Processing Procedures. The RME-III Integration activity was successfully completed per schedule and no prelaunch anomalies were identified.

2.2 ON-ORBIT

2.2.1 CREAM

The CREAM on-orbit activities were accomplished per the STS-84 timeline. Activation of the Active Monitor on the airlock ceiling and deployment of the Passive Detector Packages to the four pre-determined locations occurred at MET 00/16:20 and MET 00/16:25, respectively. The subsequent Active Monitor moves occurred as follows:

Active Monitor move #1 to the SS wall	01/14:00
Active Monitor move #2 to the Airlock ceiling	03/20:53
Active Monitor move #3 to the SS wall	05/20:35
Active Monitor move #4 to the Airlock ceiling	06/20:00

At MET 08/05:32, the scheduled CREAM deactivation occurred. At approximately MET 1/19:00, power to the CREAM unit was interrupted for about 18 minutes. It appears that power to main bus A was inadvertently switched off by MS2/Noriega. The crew

recycled power to the CREAM Active Monitor and confirmed that the green LED was on. Post-flight analysis of the Active Monitor confirmed a nominal restart. The equipment was stowed into the middeck locker and returned to the PI post-landing.

2.2.2 MSX

The PI for MSX decided to change his requirements for MSX for this and future missions based on the following facts:

- a) The cryogen is depleted meaning the IR sensor is worthless.
- b) Analysis of the Plumes from expendable rockets shows that with the sensors left, only burns at altitudes less than 160 nmi. will be of any scientific use.

Based on these facts, we requested that the Flight Control Team perform an orbit adjust burn that would allow us to observe the circularization burn at a lower altitude. However, in order to preserve Orbiter landing opportunities, this could only be done in one particular way. This way only allowed MSX opportunities during ascending passes (Shuttle coming into daylight). The MSX satellite needed the opportunity during the descending passes (Shuttle entering the night). Once this was discovered, we stood down for the mission.

2.2.3 RME-III

The RME-III on-orbit activities were accomplished per the STS-84 timeline. Activation of the RME-III units was accomplished at 2/02:52 and the units were successfully deployed in the Calibration Configuration, i.e., the side-by-side configuration. AT approximately MET 2/20:50 a memory module change out was performed and the units were placed in the East - West Effect configuration. The next memory module change out occurred at MET 04/07:42. At this time, the crew member reported that the memory module he originally placed in the unit reported a "backup mem low" message. Per the Shuttle/Mir Joint Payload Operations Checklist, a new memory module was installed and the two units were then re-deployed to the East - West Configuration.

2.3 POSTLANDING

2.3.1 CREAM

Post landing processing of some of the CREAM components was accomplished at the Shuttle Payload Processing Facility. This activity involved downloading the data from the Active Monitor; disassembling the Passive Detector Packages, and preparing the components for shipment. The Neutron Bubble detectors were returned to Canada for post-mission analysis, the Scintillation Crystals were retrieved by Dr. Cal Moss of Los Alamos and shipped to Los Alamos for analysis. The gold and nickel foils were taken back to the Defence Research and Evaluation Agency in the UK for analysis.

2.3.2 MSX

None

2.3.3 RME-III

The RME-III units were recovered from Working Group Six at the O & C Building. The units were returned to Houston for data downloading.

3.0 ANOMALIES AND CONTINGENCIES AFFECTING PAYLOAD OPERATIONS

3.1 CREAM

At approximately MET 1/19:00, power to the CREAM unit was interrupted for about 18 minutes. It appears that power to main bus A was inadvertently switched off by MS2/Noriega. The crew recycled power to the CREAM Active Monitor and confirmed that the green LED was on. Post-flight analysis of the Active Monitor confirmed a nominal restart.

3.2 MSX

None

3.3 RME-III

It was discovered that Memory Module number 12 which was attached to the Main #1 quit recording data after 18 records. This was one of two units left operating in the Spacehab after the Mir data had been collected. The units were meant to operate until AA battery power gave out. The data was not critical to the East-West test but would have been beneficial to get. There were no other data collection problems and the other Spacehab unit collected data as expected. Upon downloading the file we noticed data just stopped collection at record 18 without the usual "TOTAL" line indicating that the "STOP" button had been pressed. Inspection of the hardware upon return showed no signs of damage and the POWER in the ON position and the KEYBOARD in the LOCK position as would have been expected per the crew procedures.

To check out Memory Module 12 (with new AA batteries) it was reconnected to Main Module 1 and turned on and left to begin data collection. The unit operated normally. When data collection was terminated, the data appeared normal with the TOTAL line as expected.

Memory Module12/Main Module1 were then allowed to run until the batteries gave out. The data was later retrieved using the binary transfer method and again the data appeared normal.

It was found that the mechanical interface between Memory Module 12 and Main Module 1 had a small amount of play in it. If the Memory Module was pulled down slightly (approx 1mm) the electrical connection between the Memory Module and the Main Module was broken and the Main Module stopped data collection. The screen returned to the Setup screen instead of the "data collection" mode. This fault could be repeated regularly. The Memory Module did not need to become completely detached, just shifted slightly downward.

It is likely that when the crew returned the units from Mir, and if they connected them together with the velcro patches, separating the two units could have resulted in a temporary disconnect between the Memory Module and Main Module, causing the data collection to cease.

4.0 MEASURE OF MISSION ACCOMPLISHMENTS

4.1 CREAM

Results from the post mission analysis of CREAM data still have not been released. However, in preliminary conversations with the CREAM experimenters, the data from the Active Monitor appears to be outstanding. This is based on the mission operations log which shows an expected 181 hours, 12 minutes of data (not including the approximate 18 minutes of power outage). Assuming 41 hours 35 minutes per full segment (based on STS-81 postflight data), this would correlate to just over 4 and one-third segments of data. The downloaded data filled segments 0 through 3 and took up 22.6 Kb of segment four.

4.2 MSX

Zero percent mission accomplishment.

4.3 RME-III

Results from post-mission analysis of the RME-III data is still pending.

5.0 LESSONS LEARNED

5.1 CREAM

The holistic team approach to payload integration that was used on STS-84 proved to be of significant benefit to the project.

5.2 MSX

Trying to observe a circularization type burn will probably never be possible for MSX because of Orbiter landing constraints and MSX sensor constraints.

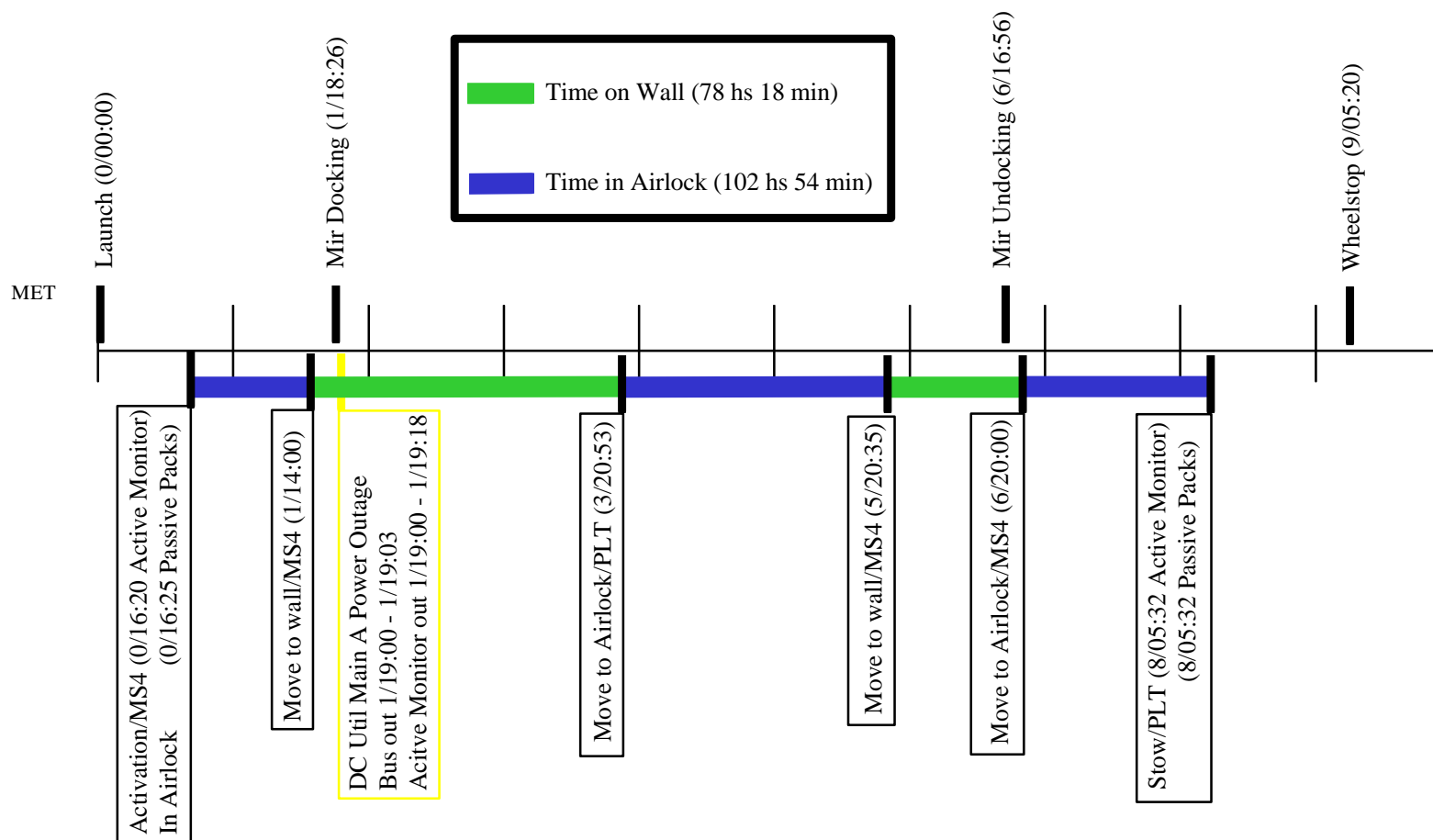
5.3 RME-III

The following recommendations were made by Major Craig Lamb to the Space Radiation Analysis Group at JSC.

1. Examine each MM to Main Module mechanical interface for loose fit. As much as 1mm of play seems to be enough to cause an electrical disconnect. Adjust the small fitting on the back of the MM to tighten the fit as needed
2. Change the procedures to have the crew check the display AFTER they have been mounted to which ever location and PRIOR to stowage in the Spacehab, for the proper data collection display.
3. Consider abandoning the use of the velcro to connect the two units together during transit. Assuming this caused the data error in the first place.
4. Consider changing the procedures to have the crew wrap gray tape from around the bottom of the Main over the back of the MM to ensure the MM does not become loose.

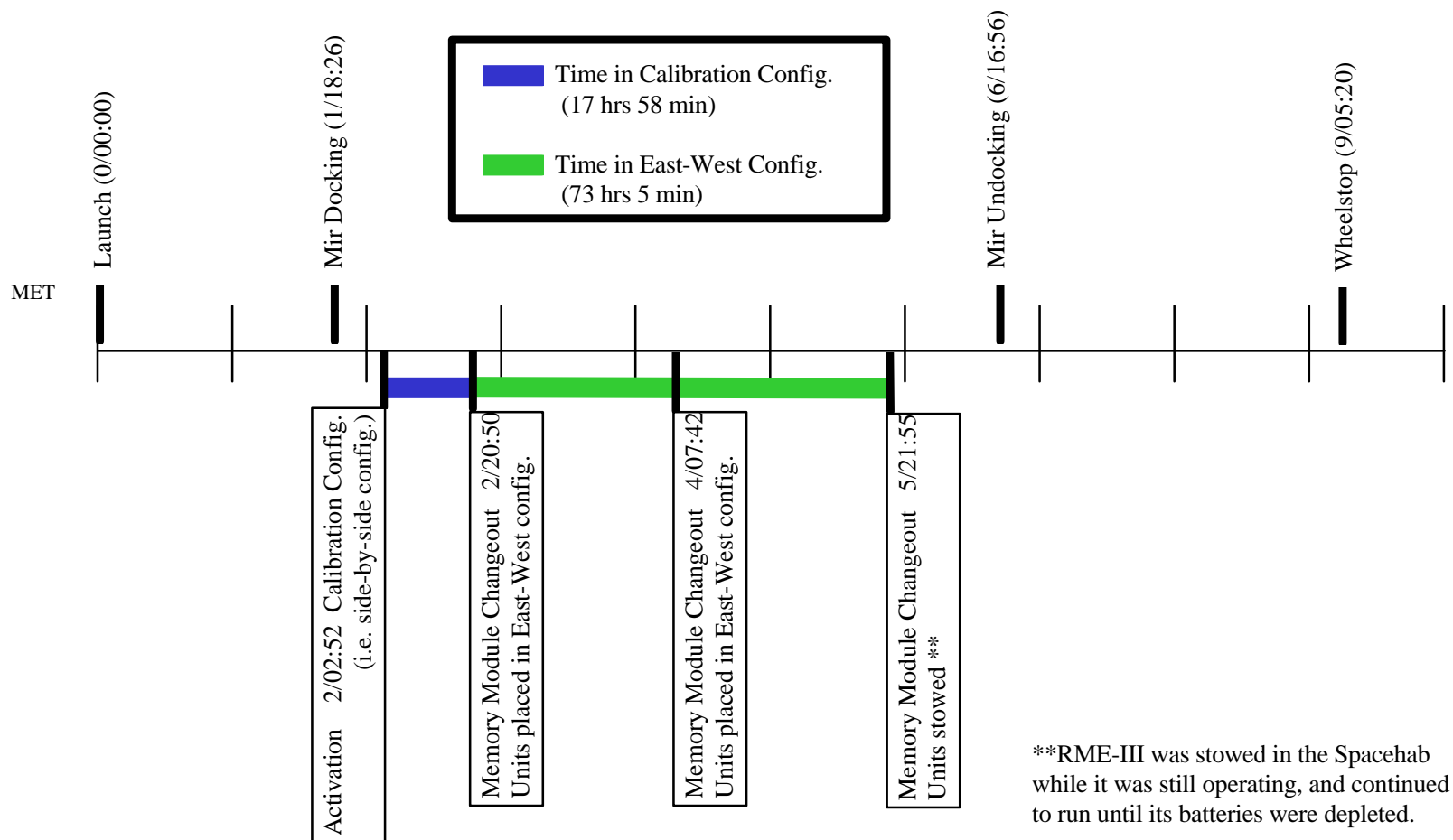
6.0 PAYLOAD ACTIVITY TIMELINE

CREAM Activity Timeline STS-84 As Flown



Launch was 03:07:48 CDT [GMT: 15 May 97, 09:07:48]

RME-III Activity Timeline STS-84 As Flown



Launch was 03:07:48 CDT [GMT: 15 May 97, 09:07:48]

7.0 FLIGHT LOG

MET	STS-84 FLIGHT NOTES May 1997
0/02:30:00	Capt Hernandez, ON-Console.
05:38:59	Had GC come by and notify me that our workstation had not been authorized to be on-line during the mission....huh? Anyway he told me I needed to contact GC at x35013 to get configured.
06:28:00	Capt Hernandez, OFF-Console.
06:30:00	Capt Hernandez back ON-Console w/Terry Hols and Darrin Walker.
06:35:00	Requested propagated SV to 7/19:00.
08:30:00	Requested status of propagated SV.
10:00:00	Received SV, ask for another SV for MET 6/18:00 (a 5 day docked mission) probably won't get it till much later today.
10:40:00	Scan done, calling Bill.
12:00:00	Summary done, Bill called.
12:30:00	Hols/Walker OFF Console.
15:43:00	Dube ON Console. (CREAM ACT) Rodriguez On Console. Brewington On Console.
15:56:00	Evans On Console.
15:56:00	Bromwell On Console.
16:30:00	MS4 called down "4:20" "4:25"
16:37:15	MCC clarified these activation times with MS4 , clarified that the METs are: 0/16:20 Active Monitor 0/16:25 PACKS All Nominal.
0/16:41	All Off Console.
1/05:48	FD Handover. P/L rated RME-III early ACT and that there will be no SIMPLEX opportunities for STS-84.
1/06:00	Walker On , Hols On.
1/06:20	Analysis started.
1/06:45	Scan done.
1/07:20	Summary done, Dimpfl called - doesn't look good.
1/07:30	Hols/Walker Off.
1/12:00	Hols/Walker On - Created some STK pictures of the two opportunities Bill identified. Talked to Bill. Bill will look at Rey's analysis tonight and e-mail results to DoD Rep. We will come in tomorrow to request NASA to lower orbit.
1/13:15	Hols/Walker Off - Hot Rod and Doobie Bro. On.
1/13:27	Howard Evans On Console (CREAM move scheduled for 1/13:45)
1/14:05	Move 1/14:00. CREAM nominal. (To SS wall)

MET	STS-84 FLIGHT NOTES May 1997
1/14:15	Dube, Rodriguez, Evans Off.
2/02:01	Lamb on.
2/02:01	Received FAX on MSX opportunity from PI
2/02:07	RME Rep has some questions.
2/02:10	Pencie On. Note: Received call down last approx. MET - 1/19:00 that power to CREAM unit had been interrupted for a period of 13-16 minutes. Apparently the bus that powers CREAM, the OCAC, and several PGSC's was inadvertently switched "OFF". RME coord.(Gene Cook) was attempting to verify MET OFF Power loss, duration of Power loss and the MET for resumption of power. It was confirmed that green LED was ON again. Requested confirmation on MET's and duration. (STK shows Atlantis was over Pacific just west of Equador at time of power loss - no SAA data lost).
2/02:52	LU rep reported RME-III activated.
2/03:16:47	Payloads confirmed that the bus power switch at MD52J (DC util Power, Main A) was inadvertently switched off last night at 01/19:03 and switched back on @ 01/19:07. CREAM was without power for 15-16 minutes, however green LED was confirmed back on.
2/04:50:07	Pencie Off.
2/06:30	Hols/Walker On.
2/07:50	Drafted flight note to send to P/Ls. This basically asks if we can play on this mission or not.
2/07:55	Started drafting a flight note describing the constraints.
2/08:14	Send FN to P/L Sys x35158.
2/07:13	We performed an analysis of the RME-III passes through the SAA. One pass is just 15 minutes before a planned Memory Module Change out. We sent a FN (CRIN052) from the RME rep to FNO and P/Ls asking that the Memory Module changeout be done MET the timeline calls out.
2/07:16	Lamb off.
2/10:45	3-4947 FDO FAX sent FDO MSX vectors.
2/10:50	Received SV from FDO and began another analysis. FDO is looking at possibilities for us.
2/11:35	FDO wants to know about moving opportunities to orbiter sunrise instead of sunset, call Bill.
2/11:50	Talked to Bill - can't do other side of Earth - Relaying this on to FDO.
2/11:55	Doesn't look good, FDO will summarize to Flight and FAX a copy to us.
2/12:30	FDO will fax a note to us explaining our incompatibilities. P/L's explained they can't support us. Hernandez, Walker, Hols OFF.
2/19:19	Lamb ON.

MET	STS-84 FLIGHT NOTES May 1997
2/19:53	Kirtland AFB dial up is not answering. Faxed two status reports to 505-846-8814.
2/19:53	Received FAX of FN FOFN038 from FDO saying there is not enough prop to lower the orbit to meet MSX requirements. Note that fps required for each NM is 1.8fps.
2/19:57	Payloads confirmed that CREAM switch was cycled after the power outage.
2/20:03:21	Pencie on.
2/20:50:57	Lu about to do RME-III memory module c/o and deploy for East-West effect. 4/06:00 - next memory mod c/o 5/20:30 - stow/memory mod c/o
2/22:16:57	Payloads asks RME rep to create flight note requesting RAD and REM from Mem Mods 1 & 2. Not going to request call down.
2/22:50:28	Pencie off.
2/23:00	Payloads will confirm the rate in the FD5 Execute Package.
2/23:58	Signed letter stating that we agree to the obvious. (that we want the Memory Module Change @ 4/06hrs) See Misc. section for copy of letter. The letter was needed because of Russian and Americans that do not know how to read the flight plan or Procedures and seem to not understand the re-planning process.
3/00:04	Lamb off.
3/20:25	Dube on. (CREAM move by Plt to a/l) Scheduled move for 3/20:45
3/20:47	Pencie on.
3/20:53	CREAM move initiated 3/20:54 completed 3/20:55 - Back in airlock. Note: These times are what was reported by pilot, despite the discrepancy in times.
4/3:25	Howard Evans on console.
4/3:30	Dube and Pencie off.
4/05:24	Pencie on. Memory Module c/o scheduled for 4/06:00.
4/07:42	Received call down from MS2. Said that readouts for 001 (?) @ 4/07:10:04 RAD: 58.41, REM: 85.73 002 (?) @ 4/07:07:55 RAD: 55.97, REM: 291.88 MS7 said that at battery replacement received ERROR message "BACKUP MEM LOW" removed mem mod - marked as bad and placed new module. Read out of RAD & REM should have been MM 003 & 004. Assumption is that the RAD & REM read is from MM 3&4.
4/08:28:59	Pencie off.

MET	STS-84 FLIGHT NOTES May 1997
5/14:20	FAO and Payloads confirmed that MS4 will do CREAM move within our "window". No exact time was given.
5/19:55	Dube and Evans on console (CREAM move to middeck , scheduled for MET 5/20:25)
5/19:59	Brewington on console.
5/20:10	Maj. Lamb on console.
5/20:35	MS4 reported successful move @ 5/20:35
5/20:44	Dube off.
5/22:00	Taped Mir tour on VHS recorder , about 50 minutes.
5/23:20	Brewington off console.
5/23:51	Asked if RME-III final stow was complete. MS3 (Clavey) said yes and will read down values in a bit.
6/00:03	MS3 called down values just prior to stow. RME-III SN1 was changed @ 5/21:54 with values MRAD 72.55 and MREM 106.73. RME-III SN2 was @ 5/21:55 and values were MRAD 89.65 and MREM 407.10.
6/00:15	Sent status report.
6/00:21	Lamb off.
6/19:25	Dube on (CREAM move to a/l scheduled for 6/19:55 by MS4)
6/19:30	Evans on.
6/20:02	MS4 moved to a/l @ 6/20:00
6/20:04	Dube/Evans off.
8/05:01	Dube on. (CREAM deact scheduled for MET 8/05:30 by plt)
8/06:18	No calldown coming. Activity was apparently performed (no anomalous reports and activities prior to and following deact (PCG STEST deact and LNDG COM CHECK) were performed. Right on schedule by plt. We will get METs from p/l Ops c/l post flight. Asked for calldown, but it doesn't look good. (Crew is now in pre-sleep).
8/06:23	Dube off. (Coordinating 24 hr waive of activity with RME rep) if applicable we would request the passive packs be deployed to their respective locations.
8/09:20	Flight note submitted for contingency. Payloads has submitted, no word on disposition. (PLIN 202) "Payload Activities Following Waveoff"
8/09:45	Dube off.
8/14:30	Lamb on. CREAM re-deployment contingency flight note was finalized as PLFN142 and approved. See Flight Note section. It looks like no changes were made.
8/14:35	Lamb off.